

### **REMARKS/ARGUMENTS**

Reconsideration is respectfully requested of the Office Action of July 10, 2009 relating to the above identified application.

A request for a three-month extension of time, together with the associated fee, is filed herewith.

By the forgoing amendment, Claims 14 and 23 have been rewritten in independent form in accordance with the Examiner's request. Compound B has been defined in accordance with the disclosure found on page 7 and para. [0016] of the published application. No new matter is presented.

The claims in the case are Claims 1 to 41.

Claims 1-13, 15-22 and 26-41 are withdrawn.

Briefly summarized, the present invention as expressed in currently amended claim 14 is a resin composition comprising a filler (A), compound (B), thermal radical initiator (C) and compound (D), and substantially not containing a photo polymerization initiator. The invention claimed in the currently amended Claim 23 is a resin composition comprising a filler (A), compound (B), thermal radical initiator (C) an allyl ester compound (G), and substantially not containing a photo polymerization initiator.

Each of the claimed resin compositions is a thermosetting resin composition used as a die attach adhesive material for semiconductors or as an adhesive material for bonding a heat dissipating member.

The compound (B) which is contained in the resin compositions of Claims 14 and 23 is a bis-maleimide compound (B') which has a structure represented by the formula (3). The bis-maleimide compound (B') is described in U.S. Patent Application Publication No. US

2007/0213467, paragraphs [0043] to [0051] and was used in the Example series A to F in this application.

A maleimide group or a derivative thereof contained in the bis-maleimide compound (B') shows, by the action of the thermal radical initiator (C) used in combination, good cross-linking reactivity when heated. Also, because of the polarity of the maleimide group or derivative thereof in the bis-maleimide compound (B'), the resin composition shows good adhesion to hard-to-adhere-to metal surfaces such as silver plating and Ni-Pd plating. In addition, because the bis-maleimide compound (B') has two or more functional groups, it is effective in sufficiently increasing the adhesion of the resin composition and preventing the resin composition from having a high viscosity. Furthermore, because the bis-maleimide compound (B') is liquid at room temperature, it is not necessary to use a solvent, and even in the case of diluting the compound, it can be diluted with a general liquid vinyl compound. By using the bis-maleimide compound (B') in a liquid state, it is possible to prevent a deterioration in the thermal conductivity of a cured product of the resin composition due to the use of a polar solvent. Also, the bis-maleimide compound (B') contains a -O-, -COO- or -OCOO- group as X of the formula (3), so that the cured product of the resin composition exhibits flexibility and has excellent low stress properties.

Moreover, the bis-maleimide compound (B') can retain low crystalline property because R5 and R6 are each a hydrocarbon group containing no aromatic group.

The compound (D) contained in the resin composition of claim 14 is a compound containing a structure represented by the formula (4) in a main chain and having at least one functional group which has a polymerizable C-C unsaturated bond. The compound (D) is described in U.S. Patent Application Publication No. US 2007/0213467, paragraphs [0057] to [0063] and [0111] to [0114] and was used in Example series A, B and F of this application.

As well as the compound (B), the compound (D) can initiate radical polymerization by a thermal radical initiator (C), and is copolymerizable with the compound (B). By using the compound (D), it is possible for a cured product of the resin composition to ensure properties such as adhesion in water treatment conditions or for adhesion to easily-oxidizable metal surfaces such as copper. Furthermore, because the compound (D) contains any of -O-, -COO- and -OCOO- groups, the cured products obtained thereby exhibit sufficient flexibility and adhesion.

The allyl ester compound (G) contained in the resin composition of claim 23 is a compound which contains an allyl ester structure represented by the formula (8). The allyl ester compound (G) is described in U.S. Patent Application Publication No. US 2007/0213467, paragraphs [0073] to [0078] and [0119] to [0120] and was used in Example series E of this application.

As well as the compound (B), the allyl ester compound (G) can initiate radical polymerization by the thermal radical initiator (C), and is copolymerizable with the compound (B). By incorporating the allyl ester compound (G) in the thermosetting resin compositions of the present invention, there is an additional advantageous effect obtained; namely, the cured product obtained by thermal curing is provided with excellent balance between adhesion and low stress properties.

Each of the resin compositions disclosed in the currently amended claims 14 and 23 has the following advantageous effects (see U.S. Patent Application Publication No. US 2007/0213467, paragraphs [0012] to [0131]):

- (1) being excellent in quick curing and usable for curing in conventionally used ovens;
- (2) being excellent in reliability such as solder crack resistance;
- (3) having a sufficient low stress property, good adhesion and, more preferably,

excellent bleeding property (a property which prevents a die attach paste from resin bleeding when the paste is applied on a roughened surface and the surface is attached);

(4) especially, as mentioned above, by using the compound (D), a cured product that is excellent in adhesion in water treatment conditions or for adhesion to metal surfaces and that is also excellent in flexibility can be obtained (Claim 14); and

(5) especially, as mentioned above, by using the allyl ester compound (G) in combination with the compound (B), a cured product that has excellent balance between adhesion and low stress property can be obtained (Claim 23).

It is shown in the above-mentioned Example series A, B and F, (Tables 1, 2 and 6) especially in series A, that excellent advantageous effects can be obtained by using the resin composition of the currently amended Claim 14 of the present invention. According to Table 1 of Example series A, the following good results were obtained in Examples A1 to A4 each of which is the resin composition claimed in the currently amended Claim 14. See [0129]:

(1) the resin compositions showed a small increase in the viscosity over time and a stable viscosity;

(2) the resin compositions showed good adhesion in any of four kinds of adhesion strength tests that were performed with or without a PCT treatment and under different curing conditions; and, even after a PCT treatment or a short curing time, the resin compositions showed good adhesion; and

(3) the resin compositions showed good solder crack resistance.

From the results shown in Table 1, the advantageous effects of cured products which are excellent in adhesion under condition in water treatment can be seen attributed to using the compound (D).

It is shown in Table 5 of the above-mentioned Example series E that advantageous effects can be obtained by using the resin compositions of the currently amended Claim 23. According to Table 5, the following good results were obtained in Examples E1, E2 and E3 each of which is the resin composition encompassed by Claim 23:

- (1) the resin compositions showed high adhesion strength in two kinds of adhesion strength tests (adhesion strength 1 and adhesion strength 2); i.e., good adhesion was obtained;
- (2) warpage of tip surface was very small which shows good low stress property; and
- (3) delamination area was very small in a reflow resistance test; i.e. the results showed good reflow resistance.

The results shown in Table 5, clearly indicate that the advantageous effect of a cured product which has an excellent balance between adhesion and low stress properties can be obtained by using the allyl ester compound (G).

Also, from the results of the additional Comparative Example E' shown in the accompanying Declaration, as will be discussed in further detail below, it has been proved that the resin composition which contains the bis-maleimide compound (B') but not containing the allyl ester compound (G) shows warpage and low stress property.

While not wishing to be bound by any theory, it is believed that the reason why the warpage of a cured product can be inhibited by using the allyl ester compound (G) is that because allyl ester groups are stable in the radical, compared with for example acrylic groups which have a similar structure, although the reaction rate is lower, the reaction becomes more stable.

The rejection of Claims 14 and 23-25 under 35 U.S.C. 102(b) as anticipated by *Uchida et al.*, JP 04-159315, is traversed and reconsideration is respectfully requested. Applicants

respectfully submit that the cited reference fails to describe the presently claimed invention for the following reasons.

The polyfunctional maleimides (b) used in Examples of the cited *Uchida* document 1 are, however, 4,4-bis-maleimide diphenylmethane and 1,3-bis-maleimide benzene, and contrary to the bis-maleimide compound (B') of the present invention, contains no -O-, -COO- and/or -OCOO- groups which function to provide flexibility and contribute to the advantages of the present invention. Also, the polyfunctional maleimides (b) used in Examples of the cited *Uchida* document contain an aromatic group. Claim 14 excludes the aromatic group.

Accordingly, the bis-maleimide compound (B') is not described in the cited *Uchida* document; therefore, the cited document fails to describe combining, in the resin composition, the bis-maleimide compound (B') with the compound (D) or the bis-maleimide compound (B') with the allyl ester compound (G). Withdrawal of the rejection is requested.

The rejection of Claims 24 and 25 under 35 U.S.C. 103(a) as unpatentable in view of *Uchida et al.*, JP 04-159315, is traversed and reconsideration is respectfully requested. The Office Action takes the position that it would have been obvious to the skilled person in the art to select the R and B residues to "meet the compounds of the instant invention by choosing two non-aromatic residues". However, the Office Action fails to present a reasoned explanation of the rationale for reaching this conclusion. The MPEP explains that a convincing line of reasoning is to be presented to support the rejection and that has not been done here. See MPEP 706.02(j). Withdrawal of the rejection is requested.

The statement at the bottom of page 4 of the Office Action falls far short of a reasoned explanation for the basis of the conclusion as to obviousness.

The rejections of Claims 14 and 23 under 35 U.S.C. 103(a) in view of *Dershem et al.*, US 6,034,194, or *Dershem et al.*, US 6,034,195, found on pages 5 and 6 of the Office Action are traversed and reconsideration is respectfully requested.

As is admitted in the Office Action, neither of the cited *Dershem et al.* documents, disclose the bis-maleimide compound (B') and the allyl ester compound (G).

The Office Action pointed out that the maleimides of the cited *Dershem et al.* documents correspond to the compound (B) of the resin composition of the present invention if Z' of X which connects a maleimide group is the polyalkylene oxide entity. In the maleimides of the cited *Dershem et al.* documents, however, X has a -COO- structure only in the case where X contains an aromatic ring, and it has no -COO- structure in the case where X is polyalkylene oxide. In contrast, the bis-maleimide compound (B') in the resin composition of the present invention contains the -COO- group and contains no aromatic ring (group). That is, the cited *Dershem et al.* documents fail to teach or suggest that by using a maleimide compound which contains -COO- group but not an aromatic ring (excluding a maleimide ring and a derivative thereof), it is possible to obtain a resin composition which can form cured products with high flexibility, excellent low stress property and excellent thermal conductivity. The Office Action fails to explain how a person having ordinary skill in the art at the time of the invention would have been led to the products as defined in applicants' claims.

Furthermore, the Examiner pointed out that in the cited *Dershem et al.* documents, the vinyl compound represented by the formula (II) corresponds to the allyl ester compound (G) of the resin composition of the present invention when R=H, there is no Q, and Y is  $-(CR_2)^t-O-CO-Ar-CO-O-(CR_1)_u-$  [R<sub>1</sub> and R<sub>2</sub>=H, t=1, u=1]. However, in the formula  $-(CR_2)^t-O-CO-Ar-CO-O-(CR_1)_u-$  of Y, the number of R groups connecting with C is two, and no double bond other than Ar is contained. Accordingly, in the formula (II), Y is not an allyl ester. Therefore, no allyl ester

compound is disclosed in the cited *Dershem et al.* documents. Also, in the cited *Dershem et al.* documents no allyl ester compound is disclosed even as a component that can be optionally added to the resin composition. That is, the cited documents each fail to teach or suggest a resin composition that can provide a cured product with excellent balance between adhesion and low stress property by combining the maleimide compound (B') with the allyl ester compound (G) with the expectation of achieving a successful result.

Filed herewith is a Declaration by two of the co-inventors named in this application. The additional evidence contained in the Declaration concerns a comparison of Examples E1, E2 and E3 with Comparative Example E1 and the additional Comparative Example E'. Comparative Example E1 contained no Compound B and Additional Comparative Example E' contained no allyl ester G. As can be readily seen from the test results regarding adhesion, warpage and reflow resistance, the Additional Comparative Example E' exhibited poor warpage and reflow resistance characteristics. Thus, applicants submit that the demonstration of unexpected results as set forth in the accompanying Declaration is convincing evidence of the non-obviousness of the claimed invention and is offered in rebuttal of the evidence contained in the Office Action of July 10, 2009. Withdrawal of the rejections is requested.

Even if those skilled in the art would have referred to any or all of the cited documents of record in combination at the time of invention, it would not have been possible for them to have predicted that a successful result would be obtained such as the advantageous effect of obtaining a cured product with low stress property and good adhesion, especially adhesion under conditions of water treatment, by using the bis-maleimide compound (B') and the compound (D) in combination.



Furthermore, even if those skilled in the art would have referred to any or all of the cited prior art documents in combination at the time of invention, it would not have been possible for them to have predicted an advantageous effect such as that the cured product would exhibit an excellent balance between adhesion and low stress property could be obtained by using the bis-maleimide compound (B') and the allyl ester compound (G) in combination.

Applicants respectfully submit that the Office Action has not established *prima facie* obviousness of the presently claimed invention.

Favorable action at the Examiner's earliest convenience is respectfully requested.

Respectfully submitted,

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